

# **ENIGMA Center for Worldwide Medicine, Imaging, and Genomics**

**The University of Southern California**

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The ENIGMA Center for Worldwide Medicine, Imaging and Genomics is an unprecedented global effort bringing together 287 scientists and all their vast biomedical datasets, to work on 9 major human brain diseases: schizophrenia, bipolar disorder, major depression, ADHD, OCD, autism, 22q deletion syndrome, HIV/AIDS and addictions. ENIGMA integrates images, genomes, connectomes and biomarkers on an unprecedented scale, with new kinds of computation for integration, clustering, and learning from complex biodata types. ENIGMA, founded in 2009, performed the largest brain imaging studies in history (N>26,000 subjects; Stein +207 authors, Nature Genetics, 2012) screening genomes and images at 125 institutions in 20 countries. Responding to the BD2K RFA, ENIGMA'S Working Groups target key programmatic goals of BD2K funders across the NIH, including NIMH, NIBIB, NICHD, NIA, NINDS, NIDA, NIAAA, NHGRI and FIC. ENIGMA creates novel computational algorithms and a new model for Consortium Science to revolutionize the way Big Data is handled, shared and optimized. We unleash the power of sparse machine learning, and high dimensional combinatorics, to cluster and inter-relate genomes, connectomes, and multimodal brain images to discover diagnostic and prognostic markers. The sheer computational power and unprecedented collaboration advances distributed computation on Big Data leveraging US and non-US infrastructure, talents and data. Our projects will better identify factors that resist and promote brain disease, that help diagnosis and prognosis, and identify new mechanisms and drug targets. Our Data Science Research Cores create new algorithms to handle Big Data from (1) Imaging Genomics, (2) Connectomics, and (3) Machine Learning & Clinical Prediction. Led by world leaders in the field who developed major software packages (e.g., Jieping Ye/SLEP), we prioritize trillions of computations for gene-image clustering, distributed multi-task machine learning, and new approaches to screen brain connections based on the Partition Problem in mathematics. Our ENIGMA Training Program offers a world class Summer School coordinated with other BD2K Centers, worldwide scientific exchanges. Challenge-based Workshops and hackathons to stimulate innovation, and Web Portals to disseminate tools and engage scientists in Big Data science. PUBLIC HEALTH RELEVANCE: The ENIGMA Center for Worldwide Medicine, Imaging and Genomics is an unprecedented global effort uniting 287 scientists from 125 institutions and all their vast biomedical data, to work on 9 major human brain diseases: schizophrenia, bipolar disorder, major depression, ADHD, OCD, autism, 22q deletion syndrome, HIV/AIDS and addictions. ENIGMA integrates images from multiple modalities, genomes, connectomes and biomarkers on an unimaginable scale, with new computations to integrate, cluster, and learn from complex biodata types.